

A COMPARATIVE INVESTIGATION OF AEROSPACE
CONCEPTS OF SIXTH GRADE TEACHERS AND
STUDENTS IN SOUTHEAST POLK SCHOOLS

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by
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CHAPTER I

INTRODUCTION

The sky is no longer the limit. Today's children live with this fact. They are aerospace citizens; they know no other age.

The launching of Sputnik startled the American people. This shock was soon felt in the schools in the areas of science and mathematics. Many schools have added aerospace courses or units to supplement and enrich the curriculum.

Truly, the inclusion of aviation and aerospace concepts contribute significantly to meeting the needs of youth. And one way to cope with the heavy demands of this jet age is to establish a jet age curriculum.¹

I. THE PROBLEM

Statement of the problem. It was the purpose of this investigation to: (1) compare the factual aerospace knowledge and background of sixth grade students and sixth grade teachers in the Southeast Polk Community School District by

¹Harold Pluimer, "Revising the Curriculum for the Space Age," Midland Schools, LXXXII (January-February, 1968), 15.

use of a survey test; (2) evaluate this information by the categories of teachers, students, and male and female participants; and (3) offer the administration of Southeast Polk Community School District a frame of reference in planning aerospace background for elementary students.

Importance of the study. The aerospace age is having profound political, economic and social effects upon our world.

Any curriculum that lays claim to relevance now or in the future must deal with the realities and possibilities of aviation and space and our aerospace age.¹

One out of every fifty people employed in the United States has been in the aerospace field.² More than one-fourth of the United States military budget has been spent for aerospace activities.³ The Apollo Space Program alone expended \$21,349 billion through July 31, 1969.⁴

¹Leslee J. Bishop, "Foreword," An Introduction to Aerospace Education, Mervin K. Strickler, Jr., (ed.) (Chicago: New Horizons Publishers, Inc., 1968), p. v.

²Raymond J. Johnson, "The Emerging Aerospace Age," Chap. I in An Introduction to Aerospace Education, Mervin K. Strickler, Jr., (ed.) (Chicago: New Horizons Publishers, Inc., 1968), p. 19.

³Ibid., p. 15.

⁴Manned Space Flight (National Aeronautics and Space Administration. Washington, D.C.: National Aerospace Education Council, October, 1970), p. 1.

The daily environment of children and adults abounds with accounts of aerospace achievements from the mass media. Reading newspapers and watching television are not enough for today's space age children. They need a sound background in aerospace in order to cope with, and adapt to, a changing world.

A teacher today may find difficulty in preparing students for tomorrow's world without an adequate aerospace knowledge. Teachers should be familiar with current aerospace information, if for no other reason than to keep pace with their students' interests and knowledge.

Teachers cannot be bystanders; ready or not, children are bringing aerospace into the classroom.

II. PROCEDURE

After much research, the investigator could find no commercial aerospace tests for elementary students. Walter Zaharevitz of the National Aerospace Education Council has said that no such tests exist. He also has said that the construction of such a test would be a valuable contribution to aerospace education.¹

From related professional literature, space telecasts, newspaper and encyclopedia references, the researcher devised

¹Statement by Walter Zaharevitz, telephone interview, February 5, 1971.

a testing instrument, including questions of factual knowledge about aerospace available to the general public. The questions included aerospace vocabulary, and information concerning the launch and re-entry of spacecraft, training of astronauts, the moon, earlier American space projects, flight of Apollo 14, and current space shots.

There were sixty-two questions in the final tabulation. The replies to one question, number fifteen, were not considered because of a typing error in the question as given. Seven tests were not counted because the student did not check the blank indicating male or female student. The test was validated by presentation to the investigator's advisor, Doctor Jack Jones of Drake University.

The test was given to all the sixth grade teachers and sixth grade students in the Southeast Polk Community School District. Teachers in each building took the test at the same time as their students. There were no time limits. Teachers were instructed not to give help on words. A total of 273 students, 147 males and 126 females, took the test as well as twelve teachers, four males and eight females. The tests were collected by the building principals and given to the investigator for scoring, tabulation and comparison.

Since the test was one with four-option questions, the Science and Social Science sections of the Stanford Achievement

Test, Intermediate II Battery, likewise with four-option questions, were reviewed.¹ This review was done to determine the percentage of questions to be correctly answered for standard grade placement.

III. DEFINITION OF TERMS USED

The following terms were used as defined below when appearing in this study.

Aerospace. The earth's envelope of air and the space above it are called aerospace.

Aerospace Education. That which leads to an understanding of atmospheric flight and space exploration and to an awareness of their profound effects upon our lives is Aerospace Education.²

IV. THE SCOPE AND LIMITATIONS OF THE STUDY

The study was conducted with a group of 273 sixth grade students, 147 males and 126 females, as well as twelve sixth grade teachers, four males and eight females. It was

¹Truman L. Kelly and others, Stanford Achievement Test, Intermediate II Battery (New York: Harcourt, Brace and World, Inc., 1964), pp. 27 and 31.

²National Aerospace Education Council, "What Is Aviation/Space Education?" cited in Earth and Space Guide for Elementary Teachers (Washington, D.C.: National Aerospace Education Council, 1965), p. 90.

given on May 27-28, 1971 in the Southeast Polk Community School District, Rural Route 2, Runnells, Iowa.

Since this study was conducted in one specific school district, the results obtained concern the factual aerospace knowledge of sixth grade students and sixth grade teachers only in the Southeast Polk Community School District.

Johnson stated that aerospace principles are derived from more than one field of science.¹ Hence, there was difficulty in planning a test which would include all phases of factual aerospace knowledge. This test was limited to sixty-two questions about aerospace chosen by the investigator. The results obtained concern only the factual aerospace knowledge as measured by these sixty-two questions.

¹Mervin LeRoy Johnson, "A Determination of Aerospace Principles Desirable for Inclusion in Fifth or Sixth Grade Science Programs" (unpublished Doctoral dissertation, Colorado State College, Greeley, 1966), p. 116.

CHAPTER II

REVIEW OF RELATED LITERATURE

Curriculum changes usually result from the needs or demands from forces outside the schools. Technical developments, economic need, and social awareness are outside forces which create the need for curriculum changes.¹ A brief summary of the history of aerospace education in the United States will follow.

I. HISTORY OF AEROSPACE EDUCATION

Putting aerospace concepts in the schools is not a new idea. As early as 1908, Polytechnical High School of Los Angeles offered a course called, "Aviation Craftsmanship and Learning to Fly."²

Beginning in 1927, the Committee of Elementary and Secondary Education of the Daniel Guggenheim Fund for the Promotion of Aeronautics promoted the cause of aviation. The committee was formed as a result of educators asking for

¹Leslie L. Thomason, "Education and Aerospace," Chap. IV in An Introduction to Aerospace Education, Mervin K. Strickler, Jr., (ed.) (Chicago: New Horizons Publishers, Inc., 1968), p. 38.

²Ibid., p. 39.

material to satisfy the growing curiosity of school children about aviation.¹

Aviation education programs were conducted in some schools in all parts of the country by the late 1920's.²

In the 1920's the need for teacher training in aviation knowledge was recognized. One of the earliest large-scale efforts in teacher education was at New York University during the 1928 summer session. It was of the survey type designed to give a wide background in aviation education for both elementary and secondary teachers. It was the forerunner of aviation workshop and in-service programs that have followed for teachers.³

There was increased activity in aviation in the 1920's and 1930's. This activity prompted the organization of committees and conferences to promote aviation education in the public schools.⁴

Doctor Roland H. Spaulding, a pioneer aviation educator, in 1928 prepared one of the first aviation education

¹Mervin K. Strickler, Jr., "History of Aerospace Education," Chap. XIX in An Introduction to Aerospace Education, Mervin K. Strickler, Jr., (ed.) (Chicago: New Horizons Publishers, Inc., 1968), p. 308.

²Ibid., p. 309.

³Ibid., p. 310.

⁴Ibid., p. 311.

bibliographies for teachers. He fostered the cause for inclusion of aviation and space concepts in the schools.¹

Another pioneer aviation educator was Doctor William F. Durand. In a speech given in 1928 he challenged the public and the schools to recognize the significance of aeronautics and the need for wise use of its services.²

By 1932 the United States Office of Education demonstrated interest in aviation education by publication of a book on training aviation mechanics.³

The Macmillan Company published a twenty-volume set of books known as the Air-Age Education Series in 1942 and 1943. The material was the result of combined efforts of educational research at the University of Nebraska and Teachers College, Columbia University.⁴

A 1944 report of aviation education in California Public Schools stated that many failures in teaching science units and other subjects had resulted from teachers having only a superficial acquaintance with basic content. The report concluded that teachers must understand something about aviation and should be air-minded.⁵

¹Ibid., p. 308.

²Ibid., p. 310.

³Ibid., p. 311.

⁴Ibid., p. 313.

⁵Aviation Education in California Public Schools
(Bulletin of the California State Department of Education.
Sacramento: 1944), p. 36.

The growing demand for air-age materials led the Civil Aeronautics Administration, in cooperation with Stanford University's School of Education, to prepare a 900-page volume, entitled: Aviation Education Source Book. Published in 1946, the book was organized to provide content information and activities in many subjects.¹

Throughout the years, since the Wright brothers' historical flight in 1905, the United States Government has been involved in many projects for the promotion of aviation. Congress has passed many acts for aviation training and aviation regulations.²

Today many organizations, both governmental and private, encourage the teaching of aerospace concepts in the public schools. The Civil Air Patrol operates one of the largest aerospace education programs in the nation.³ The Civil Aeronautics Administration has been instrumental in starting many aviation education workshops for teachers.⁴ The National Aerospace Education Council came into existence in 1950 as a national clearing house of aerospace information and ideas for all levels of education.⁵ The National Aeronautics and Space Administration provides a variety of services, resources and materials for educators and to the general public.⁶ State

¹Strickler, loc. cit.

²Ibid., p. 312.

³Ibid., p. 315.

⁴Ibid., p. 314.

⁵Ibid., p. 315.

⁶Ibid.

aviation commissions, the airlines, aerospace industries and airplane manufacturers make available consultants, materials and educational activities for the promotion of aerospace in America's schools.¹

II. PRESENT STATUS OF AEROSPACE EDUCATION

The Space Age has brought a change in thinking concerning American education. The rapid explosion of scientific knowledge puts a great challenge on the already bulging curriculum. Because the Space Age is current it carries its own built-in motivation and importance. A brief summary of the current status of aerospace education will follow.

Children are interested in the world around them. This was shown by a study in 1945. Baker collected questions from 1,500 children in grades three to six on what they would most like to know in any subject field. There were 9,280 questions; 623 questions or 38 per cent were on science.²

Although in 1945 there was little knowledge of space exploration, the study did show children were curious about the earth and solar system.

¹Ibid., p. 316.

²Emily V. Baker, "Children's Questions and Their Implications for Curriculum Planning," Teachers College, Columbia University, 1945, cited by Genevieve Bowen and Mary M. Blatt (comps.), Earth and Space Guide (Washington, D.C.: National Aerospace Education Council, 1961), p. 3.

In a booklet compiled by the National Aerospace Education Council, twenty-seven organizations offering resources for aerospace education agreed on the importance of educating children in understanding the technological, social, political, and economic impact of the Space Age. The consensus of all the organizations was summarized by one:

There now exists a sufficient body of knowledge in the area of aviation and aerospace and the skills, attitudes, and knowledge to be derived from these areas of our society are of sufficient importance as to justify the formal inclusion of aviation and space education into the traditional curriculum of our American Schools.¹

The American Association of School Administrators (AASA) has endorsed the enrichment of the curriculum through aerospace-oriented curricula. "Educators cannot leave all the aviation problems of modern society to a chance curriculum treatment, but should include them as a planned part of the curriculum."²

A space unit can be integrated into any subject at any level, Sternig noted. It can often be started when an opportune event comes up. The class discussion and questions can form the foundation for the unit.³

¹Organizations Offering Resources for Aerospace Education (Compiled for the 1970 National Congress on Aerospace Education, Seattle, Washington. Washington, D.C.: National Aerospace Education Council, 1970), p. 22.

²Thomason, op. cit., p. 39.

³John Sternig, How to Develop A Teaching Unit on Space Science (Washington, D.C.: National Aerospace Education Council, 1966), pp. 1-2.

In a discussion of innovations for the next ten years, Bernardo stated that everyone connected with the science curriculum must incorporate current space information into the classroom activities and examine the information in terms of the influences they are having on people and nations.¹

A classroom teacher reported that referring to the space unit all day in all subjects added interest.²

Johnson found that there are a great number of scientific principles suitable for inclusion in aerospace studies at the fifth or sixth grade level.³

Educators in Pennsylvania in 1959 prepared a guide for the teaching of earth and space at the junior high school level. In 1961 the educators issued an Earth and Space Guide for Elementary Teachers for use in the primary and intermediate grades. The content for the primary grades was based on questions students in elementary schools of one district said they most wanted to know about the Earth and Space.

¹James V. Bernardo, "Space-Instant Future," The Science Teacher, XXXVI (January, 1969), 40.

²Jane L. Coursey, "Blast Off!," Grade Teacher, LXXXVIII (November, 1970), 130.

³Mervin LeRoy Johnson, "A Determination of Aerospace Principles Desirable for Inclusion in Fifth or Sixth Grade Science Programs (unpublished Doctoral dissertation, Colorado State College, Greeley, 1966), p. 116.

The questions in the intermediate grade section came from a doctoral thesis compiled by a graduate student at Columbia University.¹

From the efforts of the Oklahoma Aerospace Education Workshop in 1969, a book was produced to guide the teachers of Oklahoma in teaching aerospace education in all grades.² Governor Bartlett said, "As Governor of Oklahoma, I urge all educators in the State of Oklahoma to include aerospace education at every academic level and in every field of study with the opening of our schools in September, 1970."³

Lincoln, Nebraska, educators have developed a curriculum that brings aerospace concepts into every class subject. The curriculum, completed in 1965, was developed through a grant from the United States Office of Education. It was field-tested in both public and private Nebraska schools.⁴

In a National Aeronautics and Space Administration-sponsored effort, The Aerospace Instructional Materials

¹Genevieve Bowen and Mary M. Blatt (comps.), Earth and Space Guide (Washington, D.C.: National Aerospace Education Council, 1961), preface, and p. 3.

²A Curriculum Guide for Aerospace Education (Oklahoma State Department of Education, 1970), p. iii.

³Ibid., p. ii.

⁴Lucille Howard, "All Subjects Are GO with Aerospace," American Education, LXXII (April, 1969), 5-8.

Project, a handbook in aerospace education was developed for elementary teachers. It was tested in fifty schools to insure that it was technically accurate and educationally sound.¹

The Aerospace Education Foundation and the United States Office of Education, with local and state school officials, have worked on a number of projects to put the Air Forces' new and proven space-age instructional techniques into civilian use.²

A great amount of in-service education is imperative if aerospace is to have its rightful place in the curriculum.³ "There are many teachers and school administrators who are reluctant to accept the challenges of aerospace education."⁴

Many teachers are getting the training needed to teach courses or enrich learning experiences in aerospace. Approximately 15,000 teachers each year attend summer workshops.⁵

¹Sister Mary Ivo, "Aerospace in Elementary Education," Chap. V. in An Introduction to Aerospace, Mervin K. Strickler, Jr. (ed.) (Chicago: New Horizons Publishers, Inc., 1968), p. 51.

²Technology and Innovation in Education (Aerospace Education Foundation. New York: Frederick A. Praeger, Publishers, 1968), 2.

³Woodson W. Fishback, "Aerospace and the Curriculum," Chap. III in An Introduction to Aerospace Education, Mervin K. Strickler, Jr., (ed.) (Chicago: New Horizons Publishers, Inc., 1968), p. 37.

⁴Ibid.

⁵Thomason, op. cit., p. 40.

Teachers at one in-depth workshop reported they would go back to their students much better equipped in the aerospace field.¹

Sanders did a study in 1967 to get the thinking of major aviation and space industries regarding the training of teachers in aerospace. He recommended that elementary teachers have a knowledge of history of aviation, an introduction to weather, but mainly a solid background in the study of space. He felt that secondary teachers need general aviation education and also a background in space information.²

A report on the status of high school aviation-aerospace education showed that five years ago, fewer than 100 of the nation's high schools offered any form of aerospace education course. In January, 1971, there were over 800, with the number rapidly increasing.³ The starting of a new high school course has usually come about because of an interested teacher.⁴

But aerospace still has no place in the curricula of most schools.⁵ Several reasons for this lack have been given.

¹"Aerospace and Education," Challenge, IX (Fall, 1970), 21.

²Leroy J. Sanders, "Aerospace Education for Teachers," Industrial Arts and Vocational Education, LVII (June, 1968), 29.

³C. E. Neal (comp.), High School Aviation Aerospace Education Status Report, 1971 (Denver: Sanderson Times Mirror, 1971), p. 1.

⁴Ibid., p. 12.

⁵Strickler, op. cit., p. 307.

Many teachers feel they are not properly informed in the aerospace field.¹

Few teachers are doing little more than encouraging current events, stated Sternig, perhaps because the average teacher does not have enough information available to plan a unit and the school resources offer little for children.²

Thousands of school systems and teachers have yet to recognize the importance of aviation subject matter and also are unaware of the agencies and organizations offering resources and materials.³

Pluimer has stated that the course content in aerospace education leaves much to be desired in today's curriculum. The inclusion of a course of study or merely units is a step in the right direction.⁴

Johnson reported that current elementary textbooks are not very well suited as resource material for a study of aerospace at the fifth or sixth grade level. He also stated that because aerospace principles are derived from more than one field of science, there is difficulty in providing a plan

¹A Science Workbook for the Air Age (Washington, D.C.: Civil Air Patrol, 1957), preface.

²Sternig, loc. cit.

³Aviation and Education (Washington, D.C.: Civil Air Patrol, 1958), p. 6.

⁴Harold Pluimer, "Revising the Curriculum for the Space Age," Midland Schools, LXXXII (January-February, 1968), 14-15.

of study which will include all phases of aerospace.¹

The charge that there is too much repetition in science may be justifiable, according to Floyd. The purpose of his study was to ascertain fifth, sixth, and seventh grade pupils' knowledge of science material in seventh grade science textbooks and their ability to apply this knowledge. From the results of two tests, Floyd concluded that pupils already know a considerable amount of the content in seventh grade science textbooks.²

Although not about aerospace as such, Floyd's study has implications for the use of a wide variety of sources in teaching aerospace in order to avoid needless repetition.

Everyone in our society today has access to aerospace information if he wants it. Through the mass media, people are exposed daily to accounts of scientific achievements. How knowledgeable are children from this exposure?

In a grant supported by the Link Foundation, Voss conducted a study of space age concepts of ninth grade students in the 1959-1960 school year on 271 students in three central Pennsylvania Junior High Schools. On test information, Voss

¹Johnson, loc. cit.

²Thomas W. Floyd, "An Analysis of the Knowledge of Science of Pupils Prior to Instruction in the Seventh Grade." Doctoral Dissertation, Urbana: University of Illinois, 1965. 134 pp. Abstract. Dissertation Abstracts 26:7177; No. 12, 1965.

found a very poor number of correct responses. Eighty-one per cent could not explain how an airplane is able to fly. Seventy-eight per cent did not know the difference between a rocket and a jet engine. Eighty-five per cent did not know how a jet engine operates. It was found that many students could mention space terms but had no understanding of them. From the test, a list of seventy-two space concepts for junior high age students was developed.¹

Students in the study reported they received their basic information about space most frequently in the classroom, closely followed by television and outside reading.² This finding has implications with Sander's study in that teachers must have a good understanding of aerospace, in order to properly coordinate all the sources of aerospace information for children.

Although the space program has motivated an interest in space, has the immediacy with which we learn of its happenings left children and adults somewhat bored by it all? There is some evidence that this is so.

Sadowski gave a questionnaire to liberal arts college students two weeks after the flight of Apollo 8. Only 40 per cent knew the three astronauts' names. Of the five factual

¹Burton E. Voss, "Aerospace Concepts of Ninth Grade Students," Science Education, LI (October, 1967), 391-395.

²Ibid., p. 396.

questions about the flight, 64 per cent of the male students knew all the answers and 48 per cent of the female students did. When asked the source of their information, 8 per cent checked the newspaper and 42 per cent checked television. Sadowski concluded that student interest and concern about space is somewhat waning.¹

One teacher at Temple University's Aerospace Workshop expressed the opinion that interest in space is waning in the schools just as it is in the nation.²

An article in the Des Moines Register the day after the launch of Apollo 14 flight found several people uninterested in the launch.³

III. SOURCES OF TEST QUESTIONS

The World Book Encyclopedia reprint of 1969 on Space Travel was a major source of scientific information for the investigator in formulating test questions.⁴

The reprint article was written by a program director of the National Science Foundation, and the author of many

¹Bernard S. Sadowski, "The Space Odyssey - Do Students Really Care?," School Science and Mathematics, VLXX (March, 1970), 239-244.

²"Aerospace and Education," op. cit., p. 23.

³News item in the Des Moines Register, February 1, 1971.

⁴Harold L. Goodwin, "Space Travel," The World Book Encyclopedia (Chicago: Field Enterprises Educational Corporation, 1969), reprint, 560-573.

space books. The information was critically reviewed by Wernher von Braun, a director of the Marshall Space Flight Center.

The article was organized into fifteen Topical Units covering all phases of space travel as of 1969.

The section of space travel terms was a primary source of vocabulary definitions. Other vocabulary terms were taken from the text of the article. Terms commonly heard on mass media reports of space flights were chosen.

The discussion on Getting into Space and Back led to questions concerning overcoming gravity, thrust, stages of launch vehicles, rocket fuels, re-entry problems, and some vocabulary words concerned with these matters.

The Manned Spacecraft section of the reprint article prompted questions on descent through the atmosphere, freeze-dried food, re-entry and landing equipment, and the terms retrorockets, and heat shield.

Questions relevant to space itself were taken from different units of the article.

Some of the investigator's questions were review questions at the end of the article.

A unit of Space Probes discussed the Lunar Spacecraft which United States sent up to get information about the moon before sending men there. The investigator's question

concerning which three lunar spacecraft helped the United States came from the Space Probes discussion.

In an article sub-heading, Exploring the Moon, it was stated that the gravity of the moon is only one-sixth that of the earth's gravity. Hence, the investigator formulated a question inquiring how much a 150-pound person on earth would weigh on the moon.

Four aerospace vocabulary terms were taken by the investigator from a booklet, The Space Frontier,¹ and re-written in easier form. They were: aerospace, countdown, liftoff, and trajectory.

A Radio Corporation of America pamphlet described the original manned space flight program, Project Mercury. The results of this program, as well as high altitude flights of the X-15 rocket plane, enabled the National Aeronautics and Space Administration in its building of Project Gemini, the second manned space flight. From this information, the investigator formulated questions about the name of America's first-manned space flight, the first American man to go into space, and the purpose of Project Gemini.²

¹The Space Frontier (National Aviation Education Council. Washington, D.C.: National Aerospace Education Council, 1961), pp. 21-32.

²Man and Space (Moorestown, New Jersey: RCA Defense Electronic Products, 1969), p. 23.

In a later discussion in the same pamphlet, all the Apollo programs up to Apollo 11 were discussed. The question of who was the first man to set foot on the moon came from the Apollo 11 discussion.¹

A vocabulary term "Twilight Zone" also came from this discussion.² The term dealing with the point in space where gravitational influence on earth and moon is equal was also used in a newspaper article concerning the Apollo 14 flight.³

Three questions concerning current space happenings in April and May of 1971 were included. One was the name of the Russian manned spacecraft, "Soyuz 10." In connection with this spacecraft, the main goal of the Soviet Space Program, the building of an orbiting space laboratory, was asked.⁴ A question concerning the American launching of Mariner 8 and Mariner 9 in May, 1971, was asked to see whether students and teachers knew the latest space effort of the United States.⁵

There were eight questions about the flight of Apollo 14 which began on January 31, 1971. The information could have been learned from watching television, listening to the radio, or reading newspapers or magazines during this time.

¹Ibid., p. 19.

²Ibid., p. 17.

³News item in the Des Moines Tribune, February 3, 1971.

⁴News item in the Des Moines Tribune, April 23, 1971.

⁵News item in the Des Moines Tribune, May 11, 1971.

Mass media information also could have informed teachers and students concerning much of the vocabulary, as well as knowledge about the moon, getting into space, re-entry, earlier space programs, astronauts' training, cost of the Apollo 14 flight, and general space information.

IV. SUMMARY

Beginning with a 1908 course in a Los Angeles high school, aviation has influenced school curricula. In 1928, New York University was training teachers in aviation education. By 1943, the Macmillan Company had published a twenty-volume Air Age Education Series. The National Aerospace Education Council was found in 1950 as a clearing house of Aerospace information, and since then, a variety of materials have been made available to schools by industry and government.

The Baker Study of 1945 indicated children in grades three to six were curious about the earth and solar system. Students in elementary schools of one school district were asked what they most wanted to know about Earth and Space. The findings were incorporated into a 1961 Pennsylvania guide for elementary teachers.

In 1965 Lincoln, Nebraska, educators developed a field-tested curriculum, bringing aerospace concepts into every class subject as a result of a United States Office of Education grant. A 1967 study found that major aviation and

space industry spokesmen felt that elementary teachers should know the history of aviation, the fundamentals of weather, and the principles of space.

Five years ago, fewer than 100 high schools offered an aerospace education course. In 1971, 800 offered such a course. Studies by Pluimer and Johnson have questioned the content of courses of various levels. Floyd has reported that fifth, sixth and seventh grade students often know the material in their texts before reading the book.

However, Voss' study of students in three Pennsylvania junior high schools, indicated that ninth grade students had difficulty with questions involving space concepts.

There was some evidence of waning interest in space by students.

CHAPTER III

PRESENTATION OF TEST DATA

Within this chapter, the investigator will present data concerning scores made by teachers and students on the aerospace tests. Scores will represent the percentages of correct answers by those taking the test. The investigator recognizes that since the test involves all questions with four possible answers, a score of twenty-five should be achieved by chance.

The frequencies of percentage scores of male and female students and male and female teachers appear as Tables I and II in the Appendix.¹ The test given is in the Appendix.² The analysis of these scores will be the subject of Chapter III.

The range of scores for the male students was wider than that of the female students, but the male students had a top score over six points higher than the top score of the female students as shown below:

	<u>Range</u>	<u>Difference</u>
Male students	75.8-19.3	56.5
Female students	69.3-20.9	48.4

The top male teacher score was over nine points higher

¹Appendix A.

²Appendix B.

than the top female score. However, the low score for both male and female teachers was the same.

	<u>Range</u>	<u>Difference</u>
Male teachers	80.6-54.8	25.8
Female teachers	70.9-54.8	16.1

The range of scores for all teachers was much narrower than that for either group of students. Teachers had a substantially higher low score than did the students as shown below:

	<u>Range</u>	<u>Difference</u>
All teachers	80.6-54.8	25.8
Male students	75.8-19.3	56.5
Female students	69.3-20.9	48.4

Male students had slightly higher median and mean scores than did the female students as shown below:

	<u>Median</u>	<u>Mean</u>
Male students	45.1	45.6
Female students	43.5	43.1

The male teachers' median score was over ten points higher than the median for female teachers. Male teachers had a mean score about six points higher than female teachers as shown below:

	<u>Median</u>	<u>Mean</u>
Male teachers	75.7	71.7
Female teachers	65.3	65.8

Male teachers had both a higher median and mean score than did female teachers, male students or female students. Female teachers' median and mean scores were higher than those of male students or female students. Male students had a slightly higher median and mean score than did the female students. Female students had the lowest median and mean scores of all groups as shown below:

	<u>Median</u>	<u>Mean</u>
Male teachers	75.7	71.7
Female teachers	65.3	65.8
Male students	45.1	45.6
Female students	43.5	43.1

The median and mean scores for all teachers was considerably higher than that for all students as shown below:

	<u>Median</u>	<u>Mean</u>
All teachers	68.5	67.8
All students	43.5	44.5

The median and mean percentage scores for all students were 43.5 and 44.5, respectively, with a percentage score of

25.0 expected by chance alone on a test with four-option questions.

The Stanford Achievement Test is likewise a test with four-option questions in both Science and Social Science sections.¹ For students taking the Science section test in May of their sixth grade year, a score of thirty-eight correct answers out of fifty-eight questions is necessary for standard placement. Thirty-eight correct answers represents a percentage of 65.5 for the Science section.

For students taking the Social Science section test in May of their sixth grade year, a score of 47.5 correct answers, representing 64.1 per cent, out of seventy-four questions is necessary for standard placement.

Inasmuch as the Stanford tests are timed and the investigator's test was not, it would seem that percentage scores of 43.5 and 44.5 on the latter are not high and that the aerospace knowledge of the subject sixth grades was not extensive.

¹Truman L. Kelly and others, Stanford Achievement Test Intermediate II Battery (New York: Harcourt, Brace and World, Inc., 1964), pp. 27 and 31.

CHAPTER IV

SUMMARY AND CONCLUSIONS

It was the purpose of this investigation to: (1) compare the factual aerospace knowledge and background of sixth grade students and sixth grade teachers in the Southeast Polk Community School District by use of a survey test; (2) evaluate this information by the categories of teachers, students, and male and female participants; and (3) offer the administration of Southeast Polk Schools a frame of reference in planning aerospace background for elementary students.

From related professional literature, space telecasts, newspaper and encyclopedia references, the researcher devised a testing instrument, including questions of factual knowledge about aerospace available to the general public. The questions included aerospace vocabulary, and information concerning the launch and re-entry of spacecraft, training of astronauts, the moon, earlier American space projects, flight of Apollo 14, and current space shots.

There were sixty-two questions in the final tabulation. The replies to one question, number fifteen, were not considered because of a typing error in the question as given. Seven tests were not counted because the students did not check the blank indicating male or female student. The test was validated by

presentation to the investigator's advisor, Doctor Jack Jones of Drake University.

The test was given to all the sixth grade teachers and sixth grade students in the Southeast Polk Community School District. Teachers in each building took the test at the same time as their students. There were no time limits. Teachers were instructed not to give help on words. A total of 273 students, 147 males and 126 females, took the test as well as twelve teachers, four males and eight females. The tests were collected by the building principals and given to the investigator for scoring, tabulation and comparison.

Since the test was one with four-option questions, the Science and Social Science sections of the Stanford Achievement Test, Intermediate II Battery,¹ likewise with four-option questions, were reviewed.

This review was done to determine the percentage of questions to be correctly answered for Standard grade placement.

I. CONCLUSIONS

Male teachers scored higher in every presentation of data shown. Female teachers scored lower than the male

¹Truman L. Kelly and others, Stanford Achievement Test, Intermediate II Battery (New York: Harcourt, Brace and World, Inc., 1964), pp. 27 and 31.

teachers, but higher than either the male or female students. Male students scored slightly higher than female students. Female students had the lowest scores for all groups in the data presented.

As a frame of reference for the administration of the Southeast Polk Schools in planning aerospace background for elementary students, it would seem that the student test score results showed a need for additional aerospace information to be included in the elementary curriculum.

II. RECOMMENDATIONS

It is recommended that Southeast Polk Schools develop a more adequate aerospace education program for elementary students.

It is recommended that further studies be conducted to develop testing procedures for measuring the various aspects of aerospace knowledge.

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APPENDIX A

APPENDIX A

TABLE I

FREQUENCY OF PERCENTAGE SCORES OF MALE, FEMALE SIXTH
GRADE STUDENTS, SOUTHEAST POLK SCHOOLS ON
AEROSPACE TEST, MAY, 1971

Number Males	Number Females	Percentage Score
1	0	75.8
2	0	72.5
1	0	70.9
2	1	69.3
1	1	67.7
1	0	66.1
2	1	64.5
5	7	62.9
3	3	61.2
4	2	59.6
5	0	58.0
5	1	56.4
3	4	54.8
8	3	53.2
13	5	51.6
6	5	50.0
4	4	48.3
6	8	46.7
7	7	45.1
7	11	43.5
4	5	41.9
3	8	40.3
13	12	38.7
3	4	37.0
9	5	35.4
3	6	33.8
8	6	32.2
6	4	30.6
2	5	29.0
0	3	27.4
3	3	25.8
4	0	24.1
1	1	22.5
0	1	20.9
2	0	19.3

TABLE II

FREQUENCY OF PERCENTAGE SCORES OF MALE, FEMALE
SIXTH GRADE TEACHERS, SOUTHEAST POLK
SCHOOLS, ON AEROSPACE TEST,
MAY, 1971

Number Males	Number Females	Percentage Score
1	0	80.6
1	0	79.0
1	0	72.5
0	3	70.9
0	1	66.1
0	3	64.5
1	1	54.8

APPENDIX B

- ___ 6. The push given to a rocket by its engines is called--
A. velocity. C. speed.
B. thrust. D. gravity.
- ___ 7. A man-made object that travels through space is--
A. a module. C. a planet.
B. a capsule. D. a spacecraft.
- ___ 8. Rocket fuels are called--
A. propellants. C. liquid-fuels.
B. oxidizers. D. solid-fuels.
- ___ 9. Spacecraft descend through the atmosphere with the broad end pointing in the direction of flight because--
A. it is easier.
B. they lose speed more quickly.
C. the parachutes come out sooner.
D. it can be controlled better.
- ___ 9. A spacecraft is protected on re-entry by--
A. a burnout. C. a parachute.
B. a heat shield. D. a heat exchanger.
- ___ 10. A single section of a spacecraft that can be disconnected and separated from other sections is--
A. a capsule. C. a stage.
B. a satellite. D. a module.
- ___ 11. The path described by a space vehicle is its--
A. trajectory. C. thrust.
B. stage. D. hold.
- ___ 12. A special structure from which technicians put fuel in the rocket is--
A. a space platform. C. a service tower.
B. a launch pad. D. a crawler.
- ___ 13. The point in the flight of a rocket when its fuel is used up is the--
A. breakoff. C. blowoff.
B. blastoff. D. burnout.

- ___14. The series of checks that take place from the start of rocket-launching until the rocket lifts off is the--
- A. countdown. C. cutoff.
B. hold. D. checkout.
- ___15.* The position of a spacecraft in relation to its direction of flight is called its--
- A. altitude. C. perigee.
B. apogee. D. perihelion.
- ___16. Liftoff time is called--
- A. T-one. C. T-three.
B. T-zero. D. countdown.
- ___17. A spacecraft that circles the earth or other celestial bodies is called--
- A. an artificial moon. C. an artificial satellite.
B. an artificial orbit. D. an artificial launch vehicle.
- ___18. The melting away of a heat shield during re-entry is called--
- A. abort. C. aphelion.
B. afterburning. D. ablation.
- ___19. What is a backup pilot?
- A. an automatic pilot. C. a guidance system.
B. an explorer. D. an alternate astronaut.
- ___20. At about 212,774 miles from the earth and 38,894 miles from the moon the gravitational influence of both are equal. This is the so-called--
- A. "re-entry zone." C. "transfer zone."
B. "zero zone." D. "twilight zone."
- ___21. The point at which an orbiting earth satellite is closest to the earth is called its--
- A. apogee. C. perigee.
B. aphelion. D. perihelion.

*Question 15 not used because of typographical error.

- ___22. Keeping contact with a spacecraft while in flight is called--
- A. tracing. C. tracking.
B. signalling. D. positioning.
- ___23. Some space equipment must be assembled in a special air-filtered area. This is called--
- A. an operating room. C. a precision room.
B. an assembling room. D. a clean room.
- ___24. Space is usually said to begin about ___ miles above the earth.
- A. 1,000. C. 300.
B. 500. D. 100.
- ___25. Because space is a nearly perfect vacuum--
- A. light can be seen. C. the sun cannot be seen.
B. air pressure is high. D. space is silent.
- ___26. The chief danger to men in space is--
- A. they depend entirely on their spacecraft.
B. they may be hit by meteors.
C. getting through the Van Allen belts.
D. the effects of weightlessness.
- ___27. In a three-stage rocket, the job of the first stage rocket is to--
- A. overcome gravity in the spacecraft.
B. overcome thrust in the spacecraft.
C. ignite all engines in the spacecraft.
D. lift and accelerate the spacecraft.
- ___28. The biggest problem of getting a spacecraft into space is overcoming--
- A. thrust. C. gravity.
B. lift. D. velocity.
- ___29. To reach the moon, a spacecraft must attain a speed of about--
- A. 24,300 miles per hour. C. 15,400 miles per hour.
B. 19,700 miles per hour. D. 31,200 miles per hour.

- ___30. Weightlessness happens--
- A. after the first stage falls off.
 - B. after the first earth orbit.
 - C. after leaving the earth's atmosphere.
 - D. after the third stage falls off.
- ___31. On re-entry, at about 23,300 feet, special parachutes called _____ are released--
- A. apogees.
 - B. drags.
 - C. resistors.
 - D. drogues.
- ___32. A spacecraft, on re-entry, hits the water at about--
- A. 35 miles per hour.
 - B. 22 miles per hour.
 - C. 10 miles per hour.
 - D. 5 miles per hour.
- ___33. Re-entry equipment needed by a spacecraft includes--
- A. parachutes, launch pad, and engines.
 - B. propellants, parachutes, and rockets.
 - C. retrorockets, a heat shield, and parachutes.
 - D. crawlers, retrorockets, and capsules.
- ___34. If the angle of re-entry is too shallow the spacecraft will--
- A. slow down too fast.
 - B. have a hard landing.
 - C. go back into space.
 - D. burn up.
- ___35. The first American manned space flight program was--
- A. Project Mercury.
 - B. Project Gemini.
 - C. Project Apollo.
 - D. Project Saturn.
- ___36. The first American to go into space was--
- A. John Glenn.
 - B. Gordon Cooper.
 - C. Neil Armstrong.
 - D. Alan Shepard.
- ___37. Project Gemini was a manned space flight program designed--
- A. as a follow-on to Project Mercury.
 - B. to place a man on the moon.
 - C. to test the Lunar Module.
 - D. to test a manned spacecraft.

- ___38. The first man on the moon was--
- A. John Glenn. C. Edwin Aldrin.
B. Frank Borman. D. Neil Armstrong.
- ___39. A person who weighs 150 pounds on earth would weigh about--
- A. 25 pounds on the moon. C. 150 pounds on the moon.
B. 50 pounds on the moon. D. 300 pounds on the moon.
- ___40. About how far from the earth is the moon?
- A. 300,000 miles. C. 93,000,000 miles.
B. 220,000 miles. D. 425,000 miles.
- ___41. Which three lunar spacecraft helped scientists to know more about the moon before sending men there?
- A. Luna, Mariner, and Tiros.
B. Telstar, Relay, Early Bird.
C. Ranger, Surveyor, and Lunar Orbiter.
D. Explorer, Monitor and Echo.
- ___42. The space age began on October 4, 1957. On that day, Russia launched--
- A. Sputnik I. C. Soyuz I.
B. Vostok I. D. Voskhod I.
- ___43. What federal agency directs the American Space Program?
- A. NAEC. C. FAA.
B. NASA. D. FCC.
- ___44. One of the main goals of the Soviet Space Program is to--
- A. land a man on the moon.
B. conduct experiments in outer space.
C. build an orbiting space laboratory.
D. orbit Mars.
- ___45. Some of the food the astronauts eat in space is--
- A. canned-dried. C. bite-dried.
B. freeze-dried. D. space-dried.

- ___46. The goal of Mariner 8 and Mariner 9 is to orbit--
A. Jupiter. C. Venus.
B. Neptune. D. Mars.
- ___47. In April, 1971 Russia launched a manned spaceship called--
A. Luna 10. C. Salute 10.
B. Soyuz 10. D. Zond V.
- ___48. What men are called "the fathers of space flight"?
A. Johannes Kepler and Sir Isaac Newton.
B. Jules Verne and Wernher von Braun.
C. Robert Goddard and Herman Oberth.
D. Neil Armstrong and Alan Shepard.
- ___49. Why do astronauts wear space suits?
A. to add extra weight.
B. to protect them from weightlessness.
C. to protect them from radiation.
D. to protect them from the deadly vacuum of space.
- ___50. All astronauts are either--
A. jet pilots or doctors. C. pilots or scientists.
B. Navy or Marine pilots. D. flight instructors or geologists.
- ___51. Astronauts receive most of their training at--
A. Cape Kennedy.
B. the Manned Spacecraft Center.
C. Mercury Control.
D. Flight Crew Operations.
- ___52. Which of the following is not part of an astronaut's training?
A. classroom lessons.
B. training on non-moving devices.
C. survival training.
D. building a spacecraft.
- ___53. The first Apollo spacecraft to land a man on the moon was--
A. Apollo 14. C. Apollo 13.
B. Apollo 11. D. Apollo 8.

- ___54. Members of the Apollo 14 crew were--
- A. Schirra, Eisele, and Cunningham.
 - B. Borman, Anders, and Lovell.
 - C. Shepard, Mitchell and Roosa.
 - D. Armstrong, Aldrin and Collins.
- ___55. The part of Apollo 14 that landed on the moon was the--
- A. Command Module.
 - B. Service Module.
 - C. Lunar Module.
 - D. Saturn Module.
- ___56. Apollo 14 splashed down in the--
- A. Pacific Ocean.
 - B. Atlantic Ocean.
 - C. Indian Ocean.
 - D. Arctic Ocean.
- ___57. The name of the Command Module on Apollo 14 flight was--
- A. Kitty Hawk.
 - B. Antares.
 - C. Spider.
 - D. Gumbdrop.
- ___58. The cost of the Apollo 14 moon flight was--
- A. more than \$600 million.
 - B. more than \$400 million.
 - C. more than \$200 million.
 - D. more than \$100 million.
- ___59. The launch vehicle used to send the Apollo 14 to the moon was the--
- A. Saturn V rocket.
 - B. Saturn I rocket.
 - C. Saturn IB rocket.
 - D. Saturn VI rocket.
- ___60. Apollo 14 was launched from--
- A. Corpus Christi, Texas.
 - B. Greenbelt, Maryland.
 - C. Houston, Texas.
 - D. Cape Kennedy, Florida.
- ___61. Apollo 14 landed on a region of the moon called--
- A. Hadley-Apennine.
 - B. Frau Mauro.
 - C. Sea of Tranquility.
 - D. Cone Crater.
- ___62. The section of an Apollo spacecraft where the three astronauts ride is the--
- A. Lunar Module.
 - B. Escape Module.
 - C. Command Module.
 - D. Service Module.